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Nutritional properties and value addition of mushroom: A review

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Abstract

Mushrooms are the source of food and medicine throughout the world. They are considered as low calorie food that is highly nutritive with good quality of proteins and vitamins as these are excellent source of protein as well as vitamin B complex. Fat level in mushroom is low that includes healthy unsaturated fat. Mushrooms are the potential source of nutraceuticals as some have found to comprise important amount of bioactive components. They are known to possess promising antioxidative, cardiovascular, hypercholesterolemia, antimicrobial, hepatoprotective and anticancer effects. Mushrooms may be fried, baked, boiled, creamed, roasted, pickled, and stuffed. These consist of essential amino acids such as leucine, lysine which are lacking in many staple cereal foods. Their high amino acid content make them good supplement to cereal based Indian diets like papads, besan laddos, biscuits, cookies and breads.

Keywords: Mushrooms, nutraceuticals, bioactive substances

Introduction

At global level many species of eatable mushrooms have been used for diet and medication purposes. Mushroom is the best from nutrition point of view concerning human health, diet and it can also be used for hindrance of infection (Chang, 1996) ^[9]. Mushrooms are becoming more important in our diet, due to the nutritional value, related to high protein and low fat or energy contents (Agahar–Murugkar and Subbulakshmi, 2005) ^[2]. It is probable that from its earliest beginning man has utilized mushrooms as a food. (Rahi *et al.*, 2004) ^[31]

Mushroom is an excellent source of folic acid, the blood building vitamin that prevents anaemia (Kannaiyan and Ramaswamy, 1980; Bisaria *et al.*, 1987) ^[20, 7].

Studies have shown that mushrooms contain proteins especially amino acids that are essential to human health. Mushrooms are rich in leucine and lysine amino acids, which are commonly lacking in man staple cereal foods. Proteins are essential for general growth, body tissue repair, and even maintenance of healthy cells. Some mushroom proteins have antibacterial and anticancer properties. (Cheung, 2008; Wani, Bodha & Wani, 2010; Xu *et al.*, 2014) ^[42, 40]

The word “mushroom” is most often applied to those fungi Basidiomycota and Agaricomycetes that have a stem (Stipe), a cap (Dileus) and gills (lamellae, sing. Lamella) on the underside of the cap. (Enas A.E., *et al.* 2006). The fat level in mushrooms is almost negligible. There is some fat in the cell walls, and this is sufficient fat to store vitamin D that mushrooms naturally generate after they have been exposed to sunlight. The fat that is present is mainly the healthy unsaturated fat. (Breene, 1990) ^[8].

Mushroom is an excellent source of protein (44%), crude fibre (7%) and minerals (4%). Calcium, Manganese, Magnesium and iron are important minerals which are found in mushrooms, also contains 27% moisture content & 18% Carbohydrates content. The two most important bioactive components in mushrooms are Adenosine and Cordycepin. The total amino acid content in mushroom ranges from 35 to 37%. Glutamic acid and Asparatic acid are two important amino acid found in mushroom (Hsu *et al.* 2002) ^[17].

Nutraceuticals

In addition to the nutritional components found in edible mushrooms, some have been found to comprise important amounts of bioactive component. The content and type of biologically active substances may vary considerably in edible mushrooms, their concentrations of these substances are affected by difference in strain, substrate, cultivation, developmental stage, age, storage age, storage conditions, processing & cooking practices. (P. Mattila, L. Barros, *et al.*)

The bioactive substances found in mushrooms can be divided into secondary metabolites (acids, terpenoids, polyphenols, sesquiterpenes, alkaloids, lactones, sterols, metal chelating agents, nucleotide analogs and vitamins), glycoprotein and polysaccharides, mainly B-glucans. New proteins with biological activities have also been found, which can be used in biotechnological processes and for development of new drugs including lignocellulose – degrading enzymes, lectins, protease and protease inhibitors, ribosomes –inactivating proteins, hydrophobins. (J. Erjavec, *et al.*, 2012) ^[12].

1. Carbohydrates

Polysaccharides are best known and most potent mushroom derived substances with anti-tumor and immunomodulating properties. Data on mushroom polysaccharides have been collected from hundreds of different species of β -glucans are well known for their biological activity, specifically related to immune system. Hence activating and reinforcing the host immune system seen to be the best strategy for inhibiting growth of cancer cells. Dried mushrooms are rich in carbohydrates. (<https://nbd.nal.usda.gov>)

Mushroom carbohydrates have been found in many cases to have anti cancer properties (Kalac, 2012) ^[19]. Carbohydrates, calculated by difference were also an abundant macronutrient that ranged from 52.90g / 100 g in *Lentinus edodis*, 69.74g/100g in *Boletus sp.*, 78.24g /100g. *Flammulina ventutipes* and 57.88g /100g in *Agaricus bisporous*. And the highest levels of carbohydrates were also found in *Pleurotus eryngii* (king oyster) (77.79g/100g) Although an extraordinarily high or appreciable level of total fiber was reported for *A.bisporous*, *P.Seryngii* and *P.Ostreatus* (Manzi *et al.*, 2004) ^[26] Furthermore when comparing dried mushroom to fresh or frozen mushrooms, beta-glucan content of fresh mushrooms were higher than dried mushrooms.

2. Proteins

Total protein content in mushrooms varying between 21-50%. The highest protein content was found for *Agaricus bisporous* (58.05%) and lowest was found for (23.55%). After drying, the protein content was increased significantly. (Tsongai Reid *et al.*) Edible mushrooms are good source of protein, 200-250 g/kg of dry matter, leucine, valine, glutamine, glutamic and aspartic acids are the most abundant. (E. Guiltamon *et al.*)

Protein is an important constituent of dry matter of mushrooms. (Aletor, 1995, Zrodowski, 1995) ^[3, 43] Protein content of mushrooms depends on the composition of the substratum, size of pileus, harvest time and species of mushrooms. (Bano and Rajratnam 1982) ^[5].

Mushrooms are very useful for vegetarian because they contain some essential amino acids which are found in animal proteins. (Verma *et al.*, 1987) A need for food protein compels one to explore unconventional protein sources is the single cell protein. Mushrooms are the oldest single cell protein food for man. (Sawaya *et al.*, 1985) The protein content of mushrooms are affected by number of mushrooms namely the type of mushrooms, the stage of development, the sampled level of nitrogen available and the location. (Flegg *et al.*, 1977).

3. Fats

In mushrooms, the fat content is very low as compared to carbohydrates and proteins. The fats present in mushroom fruiting bodies are dominated by unsaturated fatty acids. (Singer, 1961) In general, mushrooms are low calorie foods

since they provide low amount of fat (Diez and Alvarez, 2001). Mushrooms have 4.48% fats on dry weight basis. (Ogundana and Fagade, 1981) Total fat content in *A.bisporous* was reported to be 1.66 to 2.2/100gm on dry weight basis. (Kanwar *et al.*, 1990) Polyunsaturated fatty acids are mostly contained in edible mushrooms; thus they may contribute to the reduction of serum cholesterol. It is noteworthy that transisomers of unsaturated fatty acids have not been detected in mushrooms. The major sterol produced by edible mushrooms is ergosterol, which shows antioxidant properties. (E. Guiltman, A. Garcia- Lafuente, M. Lozano, L.Barros, Baptista). It has been observed that a diet rich in sterols is important in prevention of cardiovascular diseases. (P. Kalac).

4. Vitamins and minerals:

Mushrooms are one of the best sources of vitamins especially vitamin B (Breene 1990, Mattila *et al.*, 2002) ^[8] Mushrooms contain appreciable amount of niacin, pantothenic acid and biotin. In addition, mushroom also contain folic acid and vitamin B12 which are absent in most of the vegetables. (ude and Ezenwugo, 2001)

Mushrooms are good sources of some B vitamins like Riboflavin (vitamin B2), Pantothenic acid (vitamin B5) and Niacin (vitamin B3). These B vitamin play an essential role in the nervous system and provide energy by breaking down carbohydrates, fats and protein. (Barbara *et al.*, 2008) ^[6]

Mushrooms naturally produce vit. D when they see sunlight (or other source of UV light). Through the action of sunlight, they convert their abundant ergosterol to ergocalciferol (vit D2). Wild mushrooms in Europe commonly have 2-40 mcg vit D/100g. (Mattila 1994; Mattila 2002; Teichman 2007).

Store bought mushrooms are able to generate over 20 mcg vitamin per 100g that after being placed in sunlight for a couple of hours in the midday sun (Phillips, 2013) The vitamin D in mushrooms is easy to absorb and effective in improving Vit.D status (Urbain, 2011)

The fruiting bodies of mushrooms are characterized by a high level of well assimilated mineral elements. Major mineral constituents in mushrooms are K, P, Na, Ca, Mg and elements like Cu, Zn, Fe, Mo, Cd form minor constituents. (Bano and Rajarathnum, 1982, Bano *et al.*, 1981; Chang 1982)

K, P, Na and Mg constitute about 56 to 70% of the total ash content of the mushrooms. (Li and Chang, 1982) While potassium alone forms 45% of the total ash. The content of potassium and sodium in *A. bisporous* was 300 and 28.2 ppm resp. *A. bisporous* ash analysis showed high amount of K, P, Cu and Fe. (Abou and Helilah *et al.*, 1987) *A.bisporous* contains Ca (0.04 g), Mg (0.16g), P(0.75g), Fe (7.8g), Cu(9.4 mg), Mn (0.833mg) and Zn (8.6mg) per kilogram fresh weight.

Utilization

Mushrooms may be baked, fried, boiled, creamed, roasted, pickled and Stuffed. In India it is mostly consumed fresh. However, where mushrooms can be grown at ambient temperatures (i.e. hilly areas) but cannot be transported quickly to the consumption places, the only way to its utilization is its processing. They can be processed as canned, dried or frozen mushrooms. The vitamins in mushrooms are well retained during cooking, canning, dehydration. The moisture content in dried mushrooms should be between 5 and 8%. Drying of mushrooms is done to remove free water to such a level that the biochemical and microbial activity are

checked due to reduced water activity. (Sugana S. *et al.*, 1995; Lidhoo C.K. and Agrawal Y. C., 2006) ^[25]

Dried mushrooms rich in calories (300%), protein (10%), carbohydrates (80%) and total dietary fiber (10%) (<https://nbd.nal.usda.gov>)

Further their high lysine, leucine, valine, and tryptophan content make them good supplement to cereal based Indian diets. (Bano and Rajarathnam, 1988 and <http://nbd.usda.gov>.)

These characteristics have made them a very valuable food. Mushroom powder have been used by many researchers for development of variety of food products like mathri and rava idli. (Singh V., and Verma A., 2013) ^[35] Besan laddoo (Verma A. and Singh V., 2014) ^[40], Jam and Squash (Lakshmipathy G. *et al.*, 2013) and Biscuits (Wakchaure, G.C. *et al.*, 2010) Regula J. and Michalowska, G. (2010) successfully prepared cookies and breads with 10 and 20% dried mushroom powder added to the flour and they recommended it as a good quality dietary supplement.

A large section of population consumes papads. Papad is one of the many preserved dehydrated form of foods. Since centuries, papad has been a popular snack item of India and many varieties are available commercially (Saxena *et al.*, 1989)

Mushroom papads prepared can serve a very good source of protein, dietary fiber, calcium and phosphorous be increased with increased level of mushroom powder.

Mushroom soup powder is prepared by mixing powder of dried slices of white button mushroom or oyster mushroom with milk powder, corn flour and other ingredients. Delicious and crunchy mushroom biscuits were prepared by using the button / oyster mushroom powder and various ingredients viz., maida, sugar, ghee (bakery fats), mushroom powder, coconut powder, baking soda, ammonium bichromate and milk powder. Also it is used in the preparation of Mushroom nuggets, Mushroom ketchup, Mushroom candy and Mushroom preserve (Murabba) (G. C. Wakchaure, 2011)

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